

# The Graph of a Function and the Graph of its Derivative: Part 2

Michael Penna, Indiana University – Purdue University, Indianapolis

## Objective

To again investigate the connection between the graph of a function and the graph of its derivative.

## Narrative

Recall that for each  $x$  in the domain of the function  $f$ ,  $f'(x)$  is the slope of the tangent line to the graph of  $f$  at  $x$ , and that:

- $f$  is increasing at  $x$  if and only if  $f'(x) > 0$ , and
- $f$  is decreasing at  $x$  if and only if  $f'(x) < 0$ .

In the last project we investigated several algebraic functions. In this project we investigate several functions that are not algebraic.

## Task

1. Type the commands in the left-hand column below into MATLAB. The effect of each command is described in the right-hand column for your reference.

```
>> % Your name, today's date
>> % The Graph of a Function and the Graph of its Derivative: Part 2
>> clear all, close all           Clear MATLAB's workspace and close all figure windows.
>> syms x                         Let x be a symbolic variable.
>> % Task 1
>> f = inline('sin(x)^2-cos(2*x)') Let f(x) = sin^2 x - cos 2x.
>> f1 = diff(f(x),x)             Find f1 = f'(x).
>> figure(1)                     Declare the figure(1) window.
>> hold on
>> ezplot(f(x), [-2*pi, 2*pi])   Graph f(x) for x in [-2π, 2π].
>> ezplot(f1, [-2*pi, 2*pi])    Graph f'(x) for x in [-2π, 2π].
>> hold off
```

2. Repeat Task 1 for  $f(x) = \cos x - \cos 2x$ , graphing  $f(x)$  and  $f'(x)$  over the interval  $[-2\pi, 2\pi]$  in Figure 2. (You do not have to retype the 4 lines prior to the line “>> % Task 1”.)

3. Repeat Task 1 for  $f(x) = \sin 2x + 2 \cos x - 1$ , graphing  $f(x)$  and  $f'(x)$  over the interval  $[-2\pi, 2\pi]$  in Figure 3. (You do not have to retype the 4 lines prior to the line “>> % Task 1”.)

At this point, make a hard-copy of MATLAB's Command Window and figure windows. Then:

3. On each of the graphics you created in this project:

- draw and label by hand the coordinate axes,
- label by hand the graphs of  $f$  and  $f'$  (label the graph of  $f$  by “ $y = f(x)$ ”, for example), and
- by hand, highlight that part of the graph of  $f$  over which  $f$  is increasing, and that part of the graph of  $f'$  over which  $f'$  is positive.

Your hard copies of MATLAB's Command Window and figure windows will be your lab report for this project. Staple these hard copies together, the Command Window on top, and then your figure windows underneath, in order.